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## Sertifikaat

REPUBLIEK VAN SUID-AFRIKA

## Certificate

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This is to certify that

the documents attached hereto are true copies  
of the application form, provisional  
specification and drawings of South African  
Patent Application No. 93/1752 in the name  
of CSIR

filed 11 MARCH 1993

entitled "ATTACHING AN ELECTRONIC CIRCUIT TO A  
SUBSTRATE"teken is  
nag al

GRIA

in die Republiek van Suid-Afrika, hierdie  
in the Republic of South Africa, this22<sup>nd</sup> dag van  
day of

March 1994

Registrator van Patente  
Registrar of Patents

J.P. 018-0008

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Signed at

PRETORIA

in die Republiek van Suid-Afrika, hierdie  
in the Republic of South Africa, this22<sup>nd</sup> day of

March 1994

Registrateur van Patente  
Registrar of Patents

J.P. 5.018-0008

SPOOR AND FISHER

REPUBLIC OF SOUTH AFRICA  
PATENTS ACT, 1978

## APPLICATION FOR A PATENT

AND ACKNOWLEDGEMENT OF RECEIPT  
(Section 30 (1) - Regulation 27)REPUBLIC OF SOUTH AFRICA  
REVENUEINKOMSTE  
REPUBLIEK VAN SUID AFRIKA  
182

R 042,00

The granting of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

OFFICIAL APPLICATION No.

S &amp; F REFERENCE

21	01	931752	JP/C 861
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FULL NAME(S) OF APPLICANT(S)

71	CSIR
----	------

ADDRESS(ES) OF APPLICANT(S)

	SCIENTIA, MEIRING NAUDE STREET, PRETORIA
--	--

TITLE OF INVENTION

54	"ATTACHING AN ELECTRONIC CIRCUIT TO A SUBSTRATE"
----	--

THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2. THE EARLIEST PRIORITY CLAIMED IS:

COUNTRY: NIL	NUMBER: NIL	DATE: NIL
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THIS APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO.

21	01	
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THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 57 AND IS BASED ON APPLICATION NO.

21	01	
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THIS APPLICATION IS ACCOMPANIED BY:

- ☒ 1. A single copy of a provisional or two copies of a complete specification of 9 pages.
- ☒ 2. Drawings of 3 sheets.
- ☐ 3. Publication particulars and abstract (Form P.3 in duplicate).
- ☐ 4. A copy of Figure        of the drawings (if any) for the abstract.
- ☐ 5. Assignment of invention.
- ☐ 6. Certified priority document(s) (State number)
- ☐ 7. Translation of the priority document(s).
- ☐ 8. An assignment of priority rights.
- ☐ 9. A copy of the Form P.2. and the specification of S.A. Patent Application No.
- ☐ 10. A declaration and power of attorney on Form P.3.
- ☐ 11. Request for ante-dating on Form P.4.
- ☐ 12. Request for classification on Form P.3.
- ☒ 13. P.2 in duplicate

74	ADDRESS FOR SERVICE	SPOOR AND FISHER, SANDTON
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Dated this 14th Day of MARCH 1993SPOOR AND FISHER  
APPLICANTS PATENT ATTORNEYS

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1993-03-11
REPUBLIC OF SOUTH AFRICA DEPARTMENT OF PATENTS

SPOOR AND FISHER

FORM P.8

REPUBLIC OF SOUTH AFRICA  
PATENTS ACT, 1978  
**PROVISIONAL SPECIFICATION**  
(Section 30(1) - Regulation 27)

OFFICIAL APPLICATION NO.

21	01	931752
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LOGGING DATE

22	11.03.93
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FULL NAME(S) OF APPLICANT(S)

71	CSIR
----	------

FULL NAME(S) OF INVENTOR(S)

72	MICHAEL JOHN CAMYLLE MARSH MARK HARLEY CARSON GIDEON JOHANNES GOWS MARIO ALPHONSO MARAIS
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TITLE OF INVENTION

54	"ATTACHING AN ELECTRONIC CIRCUIT TO A SUBSTRATE"
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**BACKGROUND OF THE INVENTION**

South African patent application no. 92/0039 describes an identification system in which transponders are attached to articles to be identified, such as containers or packaged articles in a supermarket, with the transponders carrying an identification code which identifies each article, either uniquely or as one of a number of articles of a particular type.

In order for such a system to be economically viable, it is important to provide a relatively simple but effective way of attaching the transponders to the containers or packages.

### SUMMARY OF THE INVENTION

According to a first aspect of the invention a method of attaching an electronic circuit to a substrate comprises:

providing an electronic circuit having at least two electrical terminals;

securing the electronic circuit to the substrate; and

applying a conductive layer to the substrate to define an antenna, so that the conductive layer makes electrical contact with the at least two electrical terminals.

The conductive layer may comprise a conductive ink, printed in the shape of the required antenna.

According to a second aspect of the invention a method of attaching an electronic circuit to a substrate comprises:

providing an electronic circuit having at least two electrical terminals;

providing a planar conductive antenna; and

fixing the electronic and the planar antenna to the substrate, so that the antenna makes electrical contact with the at least two electrical terminals.

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The planar antenna may comprise a metallic foil with a desired shape, and may be attached to the electronic circuit prior to securing the electronic circuit to the substrate, or afterwards.

In either case, the method may include preparing the substrate to receive the electronic circuit by forming a cavity or indentation therein, for example, by punching, so that an upper surface of the electronic circuit bearing the terminals is flush with the surface of the substrate when the electronic circuit is secured to the substrate.

After the electronic circuit and the antenna are in place on the substrate, a protective layer may be applied over the electronic circuit, or both the electronic circuit and the antenna.

For example, the protective layer may comprise a layer of sealant, or may comprise a label applied to the substrate.

The electronic circuit may be an integrated circuit, and is typically a transponder.

The transponder may be programmable, with an identity code being programmed into the transponder after, or preferably before, attachment of the transponder to the substrate.

The substrate may be cardboard or another sheet material for use in forming a box or container, with a transponder thereby being incorporated into the surface of each box or container.

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### BRIEF DESCRIPTION OF THE DRAWINGS

**Figure 1** is a plan view of an integrated circuit transponder with a patch antenna applied thereto;

**Figures 2 to 6** illustrate schematically a method of programming the transponder and attaching it to a substrate;

**Figure 7** is a flow chart summarising in the steps illustrated in Figures 2 to 6;

**Figure 8** is a second flow chart, relating to an alternative method; and

**Figures 9, 10 and 11** illustrate the alternative method of attaching the transponder to the substrate.

### DESCRIPTION OF EMBODIMENTS

Figure 1 is a schematic plan view of an integrated circuit transponder 10 which is formed with three conductive terminals 12, 14 and 16 on its upper surface, and which is embedded in the surface of a substrate (see below). Applied to the substrate over the transponder 10 is a rectangular patch antenna 18 which has an elongate central slot 20. The



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patch antenna 18 is oriented so that areas on either side of the slot 20 are in electrical contact with the terminals 12 and 16 of the transponder, while the central terminal 14 of the transponder is clear of the patch antenna.

The transponder and the patch antenna are designed to operate at relatively high frequencies, in the region of 915 MHz, and the patch antenna is sized accordingly. A typical antenna is about 50 mm by 25 mm in size. The exact shape of the antenna in practice will depend on the required radiation pattern.

The substrate (not shown in Figure 1) is typically the surface of a package or container which is required to be identified by the transponder. Thus, the transponder is programmed with an identification code, which can identify the article to which it is attached, either uniquely or as one of a number of identical articles. Particularly in the latter case, where relatively low-cost articles such as packages of foodstuffs are required to be identified in a supermarket or other retail outlet, the cost of providing the coded transponder and securing it to the package becomes critical.

Referring now to Figures 2 to 6, the transponder 10 is illustrated schematically on a conveyor belt 22. A programming unit 24 stores the identification code which is to be loaded into the transponder, and is connected to the terminals 12, 14 and 16 of the transponder as it passes the programming unit by means of spring loaded pins 26. The transponder 10 contains an EPROM, and the desired identification code (typically a 38 to 64 bit code) is burnt into the EPROM. The

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transponder 10 then moves on, and a following transponder is programmed.

In Figure 4, sections of cardboard sheet 28 are shown being moved on rollers 30. The cardboard sheets are blanks which will be folded into boxes, for example, for containing foodstuffs. A punch 32 is operated as each cardboard blank passes underneath it, creating a cavity or indentation 34 at a desired location in each blank.

As shown in Figure 4, a layer of adhesive 36 is now applied to the underside of the transponder 10. Using a pick and place machine 38 (see Figure 5) the transponder 10 is located in the indentation or cavity 34 in the blank 28 as it passes the pick and place machine, so that the transponder is secured to the cardboard blank with its upper surface flush with the upper surface of the blank.

In the next step, the antenna 18 is applied to the surface of the substrate 28, by printing a conducting ink on the substrate in the required shape. The ink can be metallic or carbon based, for example, such as Colag or graphite paste. Finally, a protective coating 40 is applied to the substrate over the transponder 10 and the antenna 18, to protect it from moisture and mechanical damage. The protective coating can be another layer of ink, which is preferably non-conducting, or else may comprise a plastic sealant. As a further alternative, the protective layer may comprise a label, such as a self-adhesive label, upon which is printed a conventional bar code with a number corresponding to the identification code programmed into the transponder 10. This allows the final package to be identified both by means of the transponder 10 and

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the bar code.

The above described steps are set out in the simplified flow chart of Figure 7.

The cardboard blank 28 is now fed through the remaining stages of production, including a printing stage, and a cutting and folding stage in which the blank is formed into a cardboard box which can be filled as usual. The completed and filled box can be delivered to a retailer in the usual way, where it can be identified in a conventional manner, or by using the identification system described in South African patent application no. 92/0039.

In an alternative version of the invention, the antenna 18 is not printed on the substrate using conductive ink, but comprises a conductive foil layer which is applied to the surface of the substrate. This version of the method is set out in the simplified flow chart of Figure 8, and is illustrated in Figures 9 to 11. The antenna 18 comprises a sheet of self-adhesive foil 42, which is stamped or pre-cut from a foil strip. As shown in Figure 9, the integrated circuit 10 is connected to the underside of the foil strip 42, in an area where the adhesive layer on the foil strip has been removed, using a conductive adhesive. Ideally, a number of transponders 10 are attached to respective foil antennas and are provided on a continuous roll for application to cardboard blanks in a printing process.

As shown in Figure 10, the transponder/antenna sub-assembly is placed in abutment with the cardboard substrate 28, so that the transponder 10

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is located in the punched cavity or indentation 34. A roller is passed over the transponder/antenna sub-assembly to secure it to the cardboard blank, with the completed assembly shown in Figure 11.

The above described methods make it possible to attach integrated circuit transponders (or other electronic circuits) to suitable substrates in large volumes, allowing the implementation of an automatic identification system which can be applied to large numbers of articles of a relatively low cost.

DATED THIS 11th DAY OF MARCH 1993



SPOOR AND FISHER  
PATENT ATTORNEYS FOR THE APPLICANT

CSIR  
 PROVISIONAL SPECIFICATION

3 SHEETS  
 SHEET 1

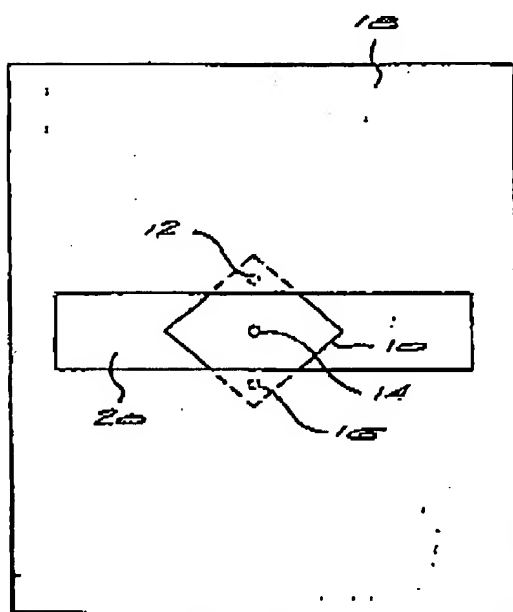


Figure 1

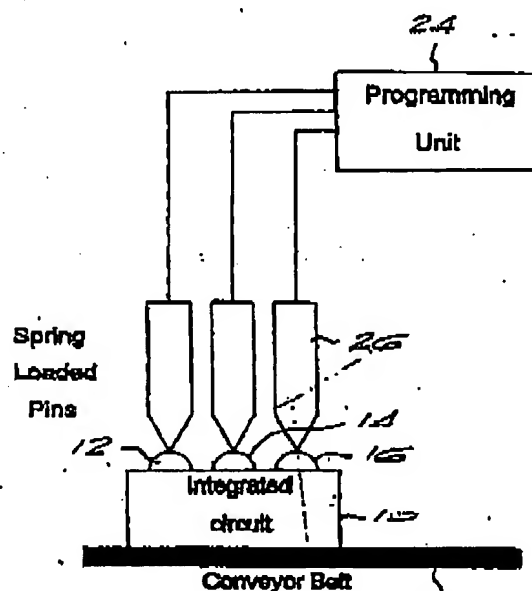


Figure 2

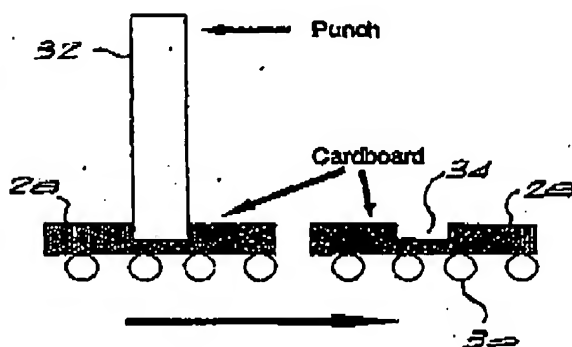


Figure 3

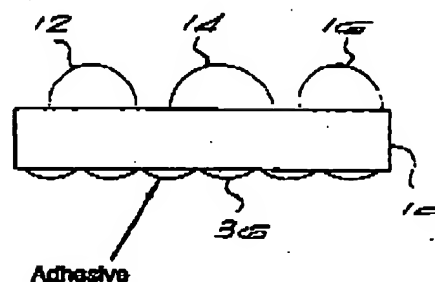


Figure 4

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3 SHEETS  
 SHEET 2

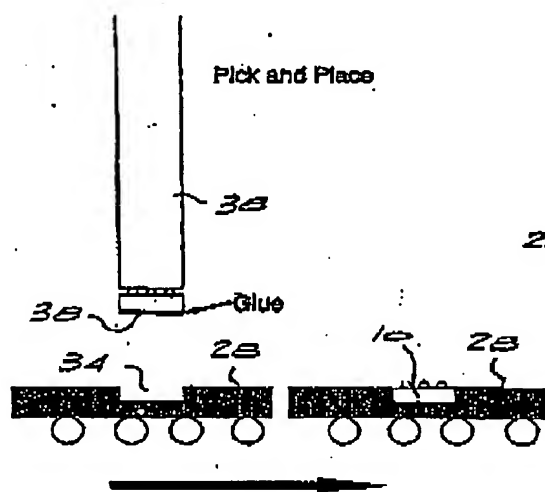


Figure 5

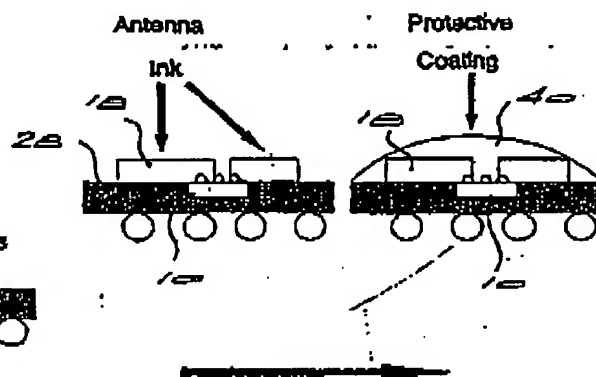


Figure 6

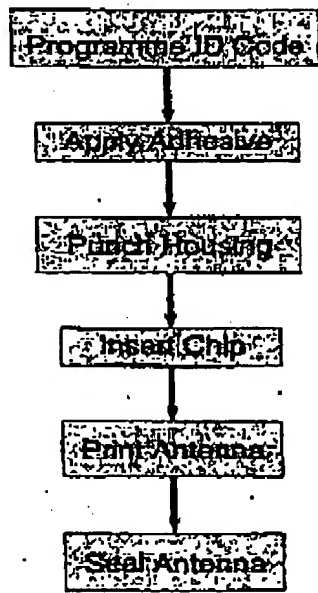


Figure 7

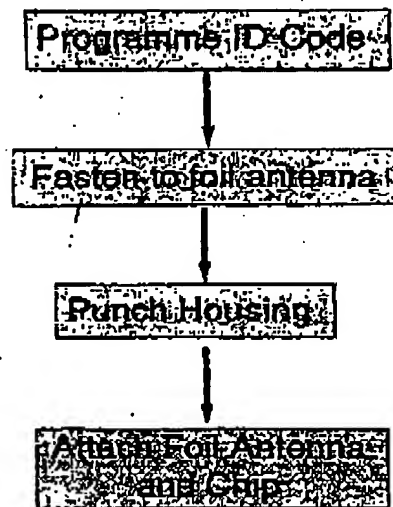


Figure 8

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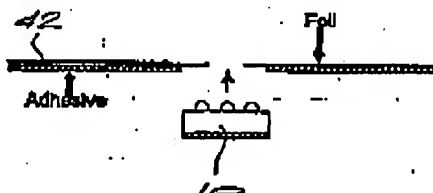
CSIR  
PROVISIONAL SPECIFICATION3 SHEETS  
SHEET 3

Figure 9

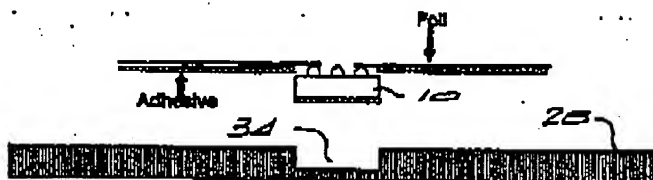


Figure 10



Figure 11

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